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EIS 2008 Proceedings | Benelux (BENAIS)

2008

Placing Process Intelligence within the Business Intelligence Framework

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Abstract: Recently we have seen a trend of increasingly process-aware information systems and architectures. The application of Business Process Management ever more determines the information systems research agenda, as well as the ICT industry. As more process-related data and models become available, techniques have been introduced that attempt to extract intelligence and mine process information. In this paper, we provide an overview of existing Process Intelligence research, and position the concepts and techniques within the Business Intelligence framework, providing a common ground for both current and future research.

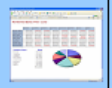
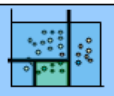
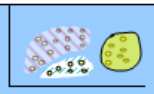
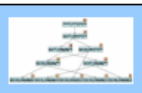
Nowadays, IT is subject to an increasing pressure from the businesses demanding a higher added value and lower costs. Business process management (BPM) has become a key issue in information systems architecture and deployment. The first assignment in BPM is to know and model the business processes, and to measure and benchmark the implementations that represent the actual business processes. Next, they have to be analyzed, evaluated, and possibly redesigned. Business Process Intelligence (BPI) is a concept that can be described as the application of Business Intelligence (BI) techniques (such as performance management, OLAP analysis, data mining, etc.) in BPM in order to understand and improve the company's processes.

The emergence of BPM makes that process components are getting introduced into the information systems more explicitly, thereby moving to process aware information systems. As information systems typically log data related to the jobs they perform, process aware information systems will log events related to processes in addition to transaction related data. This offers opportunities for a myriad of Business Intelligence techniques on process data, in order to analyze process data and obtain process. We provide an overview of Process Intelligence tasks and techniques and place them within a BI context. Process intelligence is not an isolated concept. By looking at Process Intelligence from a Business Intelligence perspective, techniques and solutions that have been well researched within Business Intelligence, can serve as a basis and an inspiration for Process Intelligence research and practice.

Business Intelligence refers to an interactive process for exploring and analyzing structured, domain-specific data, usually stored in data warehouses, to discern business trends or patterns, thereby deriving insights and drawing conclusions. Business intelligent systems are developed to support strategic and tactical decisions and to asses business performance.

As Business Intelligence entails a wide domain of tasks and techniques, we describe a framework, in which we make a distinction between analysis and reporting, data mining, control flow discovery, pattern matching and finally complexity measures.

Table I. Process Intelligence within the Business Intelligence framework

Applications	*Marketing*		Direct Advertising	Response Probability	Customer Profiles	Market Basket Analysis,	Market Basket Analysis			
	Web		Taxonomy		Clusty.com		Web Usage Mining	Click Stream Analysis		
	Software Engineering			Effort Estimation	Clustering Services into Components			Reverse Engineering Program Understanding [Zhang 2006]	Counter-Plagiarism	Progam Complexity measures
	Financial Engineering	CPM, BAM	Bankruptcy Prediction, Fraud Detection	Loss Given Default	Fraud Profiles					
	Counter-Terrorism		Terrorist Recognition		Terrorism Profiles	Terrorism networks Health Care Fraud [Yang 2006]			Face recognition fingerprints	
	Bio-informatics		Medical Diagnosis				Find Sequences of Genes responsible for a certain disease			
	Process Mining	Process analysis Simple performance metrics Compliance Queries (4-eyes principle)	Decision Point prediction: Predicting the next task at given decision points [Rozinat BPM2006]	Performance prediction: Predicting the performance given event logs	Event log preprocessing: Clustering similar events (tasks) into meaningful clusters of events [Ellis BPM2006]	Social Networks: who ... with whom? [vanderAelst 2006a] Handover of work Subcontracting Working together Reassignments Doing similar tasks	Process model mining [Hwang 2004] discovery of temporal patterns from process instances	Process discovery What is the process [vanderAelst 2006a]	Delta analysis: what is the difference between two processes [Medeira BPM2006, [vanderAelst 2005]]	Workflow complexity [Cardoso BPI2006]
Tasks		 Analysis and reporting	 *Classification*	 *Regression*	 *Clustering*	 *Association rules*	 *Sequences*	 *control flow discovery*	 *Pattern matching*	 *Measuring Complexity*
			Supervised learning		*Unsupervised learning*					
Techniques		OLAP statistics	C4.5 logit SVM AntMiner+ NN	CART logit SVM NN OLS regression	SOM k-means hierarchical clustering	Apriori	Apriori Modified Apriori	flow analysis	similarity measures	complexity measures